SD
11
.A1
A42
no 265
1985

Forest Service

United States Department of Agriculture

FS–265

Sitka Spruce

An American Wood

Sitka spruce, the largest of the world's spruces, is one of the most prominent forest trees along the northwest coast of North America. It is seldom found far from tidewater, where moist maritime air and summer fog help maintain the humid conditions necessary for its growth. Throughout most of its range from northern California to Alaska, Sitka spruce is associated with western hemlock in dense stands where growth rates are among the highest in North America. It is a valuable commercial timber species for lumber, pulp, and many special uses.

F–253874

Sitka Spruce

(*Picea sitchensis* (Bong.) Carr.)

A. S. Harris[1]

Distribution

Sitka spruce grows in a narrow strip along the north Pacific coast from latitude 61° N. in south-central Alaska to 39° N. in northern California (fig. 1). It is restricted to an area of maritime climate with abundant moisture throughout the year, relatively mild winters, and cool summers. Summer temperatures are lower in the northern latitudes and lack the extremes found in the southern part of the range.

The most extensive portion of the range in both width and elevation is in southeast Alaska and northern British Columbia, where it extends for about 130 miles east to west and includes a narrow mainland strip, the many islands of the Alexander Archipelago in Alaska, and the Queen Charlotte Islands in British Columbia. North and west of southeast Alaska, along the Gulf of Alaska to Prince William Sound, the species is restricted by steep mountains and glaciers edging the sea. Within Prince William Sound, the range widens to about 60 miles to include many offshore islands and narrows farther west. It extends across Cook Inlet to Cape Kubugakli and across Shelikof Strait to the islands of the Kodiak Archipelago.

In British Columbia, the range includes a narrow mainland strip and offshore islands. The best tree development is on the Queen Charlotte Islands. On Vancouver Island, the best development is on the northern tip and west side. On the east side of Vancouver Island and on the mainland south to Washington, the species tends to be restricted to sea-facing slopes and valley bottoms.

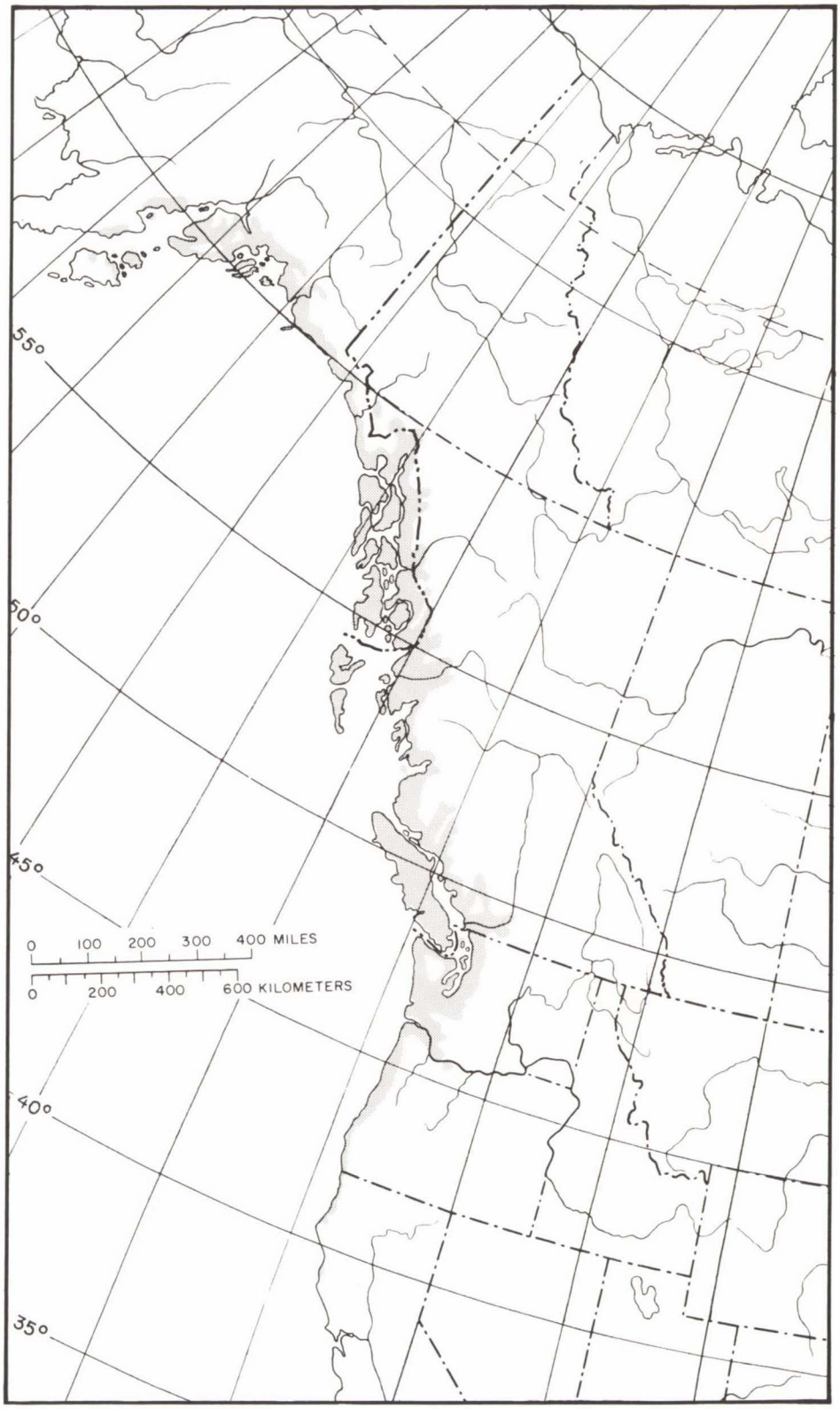

Figure 1—Natural range of Sitka spruce. F-532742

[1]Principal Silviculturist, U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Forestry Sciences Laboratory, Juneau, Alaska.

Figure 2—Mature Sitka spruce. F–397927

In Washington, Sitka spruce grows in a narrow mainland strip along the Strait of Georgia, around Puget Sound, up river valleys to the east, and on the Olympic Peninsula. On the west side of the Olympic Peninsula, it grows on the extensive coastal plain and seaward mountain slopes. The range narrows farther south along the Washington and Oregon coast, but extends inland for several miles along the larger rivers. In northern California, it is discontinuous and extends south to Mendocino County.

Sitka spruce occasionally forms pure stands, but is commonly associated with western hemlock (*Tsuga heteropylla*) throughout most of its range. Toward the south, other conifer associates include Douglas-fir (*Pseudotsuga menziesii*), Port-Orford-cedar (*Chamaecyparis lawsoniana*), western white pine (*Pinus monticola*), and redwood (*Sequoia sempervirens*). Shore pine (*Pinus contorta* var. *contorta*) and western redcedar (*Thuja plicata*) are also associates that extend into southeast Alaska. Toward the north, conifer associates also include Alaska-cedar (*Chamaecyparis nootkatensis*), mountain hemlock (*Tsuga mertensiana*), and subalpine fir (*Abies lasiocarpa*)—trees that are usually found only at higher elevations toward the south. White spruce (*Picea glauca*) is also associated with Sitka spruce in Alaska, and hybrids occur. The most important hardwood associates are red alder (*Alnus rubra*) and bigleaf maple (*Acer macrophyllum*) in the south and red alder and Sitka alder (*Alnus sinuata*) toward the north. Black cottonwood (*Populus trichocarpa*) is an associate throughout the range.

Description and Growth

Sitka spruce is a vigorous, fast-growing tree usually dominant in the forest canopy. It is an impressive, tall, straight tree with an evenly tapering trunk. Mature trees often develop enlarged, swollen, and buttressed bases and open conical crowns (fig. 2).

Figure 3—Foliage, cones, and bark of Sitka spruce. Note the thin bark as shown in the chopped-out section.

F-70501

Cones of Sitka spruce are usually 2 to 3-1/2 inches long, cylindrical, and light brown (fig. 3). At maturity, scales are thin, rounded, and papery, with irregular notches or teeth. Needles are 5/8 to 1 inch long, sharp-pointed, flattened, and thin, with two whitish bands on each side. They extend from all sides of twigs. Needles are somewhat diamond-shaped in cross section. The outer bark is dark purplish and brown, thin, scaly, and relatively smooth; the inner bark is white with brown spots. Good cone crops occur at 3- to 5-year intervals in the southern part of the range and at 5- to 8-year intervals in Alaska. Individual trees occasionally produce cones before 20 years of age, but cone bearing usually does not begin until ages 20 to 40.

Seedling survival is exceptionally good because moisture is almost always adequate and seedlings are somewhat tolerant of shade. After the seedling stage, however, trees require overhead light for rapid growth.

Height growths of Sitka spruce and western hemlock are nearly equal during their periods of most rapid growth, but spruce grows more rapidly in diameter. Consequently, thinning mixed stands of smaller trees tends to favor spruce. Spruce maintains height growth longer than hemlock and lives longer. Few hemlock live more than 500 years, but Sitka spruce may live to 700 or 800 years. Very old spruce trees eventually become dominant in old-growth hemlock–spruce stands. The largest Sitka spruce on record is located near Seaside, Oreg. It is 16.7 feet in diameter, 216 feet tall, and has a crown spread of 93 feet. Mature trees on the Tongass National Forest in Alaska average 160 feet in height and 3 to 5 feet in diameter at breast height.

Blowdown probably causes the most serious damage to Sitka spruce, but the species is also attacked by insects, disease organisms, and animals. The white pine weevil (*Pissodes strobi*) causes the most serious damage in Oregon, Washington, and southern British Columbia and has been the most serious deterrent to management of Sitka spruce in the southern part of its range.

Common Names

Sitka spruce is named for Sitka Island (now known as Baranof Island) in southeast Alaska where the species was discovered and named by Europeans in 1832. Sitka spruce is also known as coast spruce, tideland spruce, and yellow spruce.

Related Commercial Species

Sitka spruce is sometimes marketed with white spruce, true firs, and other softwood species and included in estimates of these resources. A natural hybrid between Sitka spruce and white spruce (*Picea* ×*lutzii* Little) occurs in the Skeena River Valley of British Columbia and on the Kenai Peninsula in Alaska. The hybrid shows some resistance to the white pine weevil. Sitka spruce is also known to cross with Yezo spruce (*Picea jezoensis*), Serbian spruce (*P. omorika*), and Engelmann spruce (*P. engelmannii*).

Supply

The volume of Sitka spruce sawtimber on commercial forest land in the United States is estimated at 71,341 million board feet (International ¼-inch rule). Alaska contains 89 percent of this volume; Washington, Oregon, and California, 11 percent.[2]

Production

Annual production of Sitka spruce lumber steadily increased to 165 million board feet by 1899. Production reached an all-time maximum of 508 million board feet during World War I because of demand in the aircraft industry. After the war, production declined to less than 80 million board feet until World War II, when it exceeded 400 million board feet. Since World War II, production has declined.

The Alaska sawmills that cut Sitka spruce produce a small volume of standard lumber items for local markets. Most of the logs, however, are cut into cants (squared-off logs) for export; more than 98 percent of these are shipped to Japan. The amount of sawn timber exported from Alaska has declined over the last decade (fig. 4). The export of round logs has increased, however, following the transfer of Federal lands to private ownership as a result of the settlement of Alaska Native land claims. This is because Federal restrictions on the export of round logs do not apply on privately owned land in Alaska. Only a small volume of Sitka spruce is exported from the Pacific Northwest.

Characteristics and Properties

The sapwood of Sitka spruce is creamy white to light yellow and blends gradually into the heartwood, which is pinkish yellow to brown. Sapwood in mature trees may be 3 to 6 inches wide and wider in young trees.

The wood has a fine, uniform texture, generally straight grain, no distinct taste or odor, and relatively few resin ducts. The annual rings are distinct, with a band of lighter colored earlywood shading gradually into a narrower band of darker latewood.

[2]LaBau, Vernon J.; Personal communication. Anchorage, AK: Forestry Sciences Laboratory.

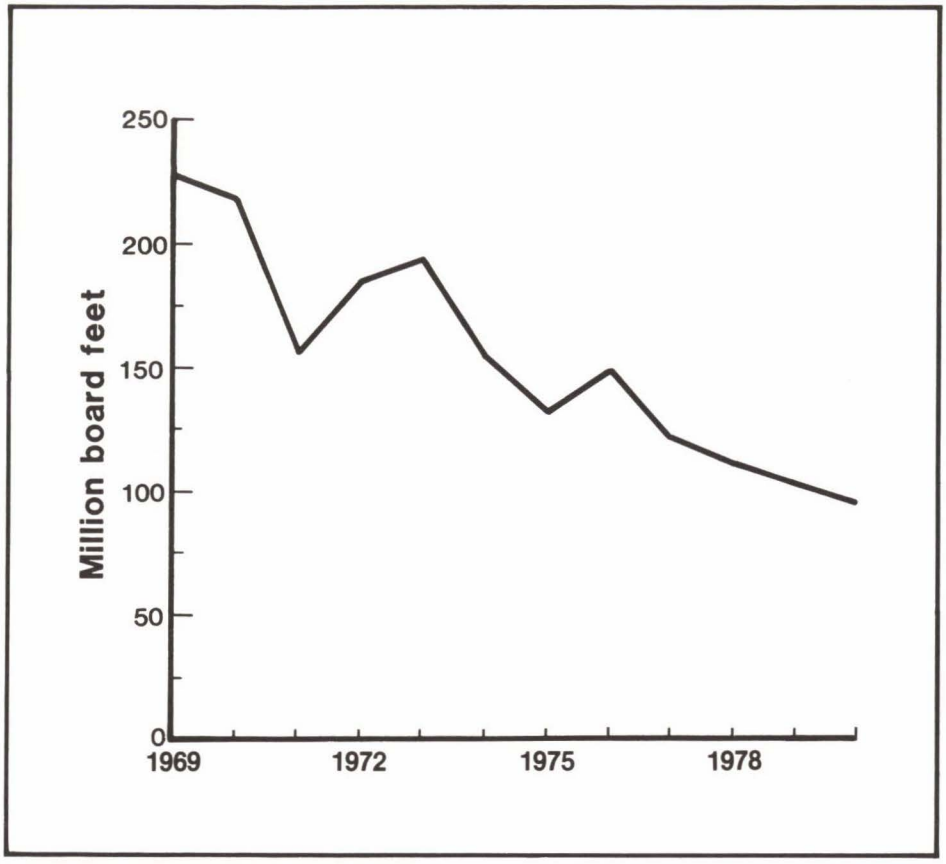

Figure 4—Sitka spruce lumber exported from Alaska ports, 1969–80.

Sitka spruce wood is classed as moderate in weight, stiffness, hardness, resistance to shock, shrinkage, bending, and compressive strength. It ranks high in strength on a weight basis. The average specific gravity is 0.37, based on green volume and ovendry weight. The average density of air-dry wood (12 percent moisture content) is 28 pounds per cubic foot.

The availability of Sitka spruce in large, clear, straight-grained pieces and its high strength-weight ratio accounted for its early demand for use in aircraft.

The wood is not difficult to kiln-dry and can be worked easily if it is free of knots. Sitka spruce has low resistance to decay; and when long life is required, it should not be used untreated. It is resistant to impregnation with preservatives under pressure, but can be treated by a water-diffusion process. Thin panels of slow-growth Sitka spruce are highly resonant, making them desirable for piano sounding boards.

Wood from young, managed stands generally lacks the knot-free, slow-growth characteristics of old-growth trees. Experience from the United Kingdom, where Sitka spruce has been extensively planted, shows that the wood from young trees is suitable for many construction purposes, but is often unsuitable for joinery. Machining trials have shown that sharp cutting edges are needed to produce a good planed finish, but the numerous hard knots damage cutters rapidly.

Sitka spruce makes excellent pulp because of its long, strong fibers and the ease with which it can be processed. The wood is readily reduced by the sulfite chemical process to yield a strong pulp. Its texture is not as fine as that of white spruce, but it bleaches easily, making it suitable for the manufacture of newspaper and high-grade printing and bond papers. It also produces high-grade chemical pulps used to make rayon and plastics. The wood can also be reduced by the sulfate process to yield a strong pulp suitable for high-grade kraft wrapping papers and fiberboards. When made into pulp by the groundwood (mechanical) process, it yields a product suitable for many uses, such as newsprint, low-grade papers, and absorbent material.

Principal Uses

Major uses are for lumber and pulpwood, especially in Alaska, where 89 percent of the Sitka spruce in the United States grows.

The high strength-to-weight ratio and resonant qualities of clear lumber are attributes that have traditionally made Sitka spruce wood valuable for specialty uses. Today, these uses include sounding boards for high-quality pianos, guitar faces, ladders, and components of experimental light aircraft. Other products are oars, planking, masts, and spars for boats and turbine blades for wind-energy conversion systems.

References

Brazier, J. D.; Priest, D. T.; Lavers, G. M.; White, N. C. An evaluation of home-grown Sitka spruce. Current Paper 20/76. Garston, Watford: Building Research Establishment; 1976. 26 p.

Fowells, H. A., comp. Silvics of forest trees of the United States. Agric. Handb. 271. Washington, DC: U.S. Department of Agriculture; 1965. 762 p.

Harris, A. S. Sitka Spruce—Alaska's new State tree. Am. For. 70(8): 32–35; 1964.

Harris, A. S.; Ruth, Robert H. Sitka spruce—A bibliography with abstracts. Res. Pap. PNW–105. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1970. 251 p.

Hartman, Kay. National register of big trees. Am. For. 88(4): 17–31, 34–48; 1982.

Little, Elbert L., Jr. Checklist of United States trees (native and naturalized). Agric. Handb. 541. Washington, DC: U.S. Department of Agriculture; 1979. 375 p.

Panshin, A. J.; DeZeeuw, Carl; Brown, H. P. Structure, identification, uses and properties of commercial woods of the United States. 2d ed. New York: McGraw-Hill; 1964. 643 p. (Textbook of wood technology, vol. 1).

Ruderman, Florence K. Production, prices, employment, and trade in Northwest forest industries, fourth quarter 1980. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1981. 46 p.

Ruth, Robert H.; Harris, A. S. Management of western hemlock–Sitka spruce forests for timber production. Gen. Tech. Rep. PNW–88. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1979. 197 p.

Viereck, Leslie A.; Little, Elbert L., Jr. Alaska trees and shrubs. Agric. Handb. 410. Washington, DC: U.S. Department of Agriculture; 1972. 265 p.

U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. Wood handbook: wood as an engineering material. Agric. Handb. 72. Rev. ed. Washington, DC: U.S. Department of Agriculture; 1974. 428 p.

Revised February 1984

☆ U.S. GOVERNMENT PRINTING OFFICE : 1984 O - 415-844 (Item 4)